CLAIMS

1. An anode material for non-aqueous electrolyte secondary battery,

the anode material consisting of carbon fiber capable of carrying out doping/undoping of lithium,

the carbon fiber being such that area replenishment rate defined as value obtained by dividing area of the cross section thereof by the minimum area of circumscribed rectangle surrounding the cross section is 0.8 or more.

2. An anode material for non-aqueous electrolyte secondary battery as set forth in claim 1,

wherein circularity defined as value obtained by dividing length of circumference of complete round of which area is the same as that of the cross section of the carbon fiber by length of contour line of the cross section of carbon fiber is 0.8 or more and is less than 1.0.

3. An anode material for non-aqueous electrolyte secondary battery as set forth in claim 1,

wherein the carbon fiber is graphitized carbon fiber.

4. An anode material for non-aqueous electrolyte secondary battery as set forth in claim 3,

wherein bulk density of the graphitized carbon fiber is 0.4 g/cm^3 or more.

5. An anode material for non-aqueous electrolyte secondary battery as set forth in claim 3,

wherein true density of the graphitized carbon fiber is 2.1 g/cm^3 or more.

6. An anode material for non-aqueous electrolyte secondary battery as set forth in claim 3,

wherein specific surface area of the graphitized carbon fiber is $9m^2/g$ or less.

7. An anode material for non-aqueous electrolyte secondary battery as set forth in claim 3,

wherein, in the grain size distribution of the graphitized carbon fiber, accumulated 10% particle diameter is 3μm or more, accumulated 50% particle diameter is 10 μm or more, and accumulated 90% particle diameter is 70 μm or less.

8. An anode material for non-aqueous electrolyte secondary battery as set forth in claim 1,

wherein when it is assumed that thickness of the thinnest portion of carbon fiber is T, length in a long axis direction thereof is L and length in a direction perpendicular to the long axis is W,

value of shape parameter X calculated by the following formula is 125 or less:

$$X = (W/T) \times (L/T)$$

9. A non-aqueous electrolyte secondary battery comprising:

anode consisting of carbon material capable of carrying out doping/undoping of lithium, cathode, and non-aqueous electrolytic solution in which electrolyte is dissolved in non-aqueous solvent,

wherein, as carbon material constituting the anode, there is

included carbon fiber in which area replenishment rate defined as value obtained by dividing area of the cross section thereof by area of circumscribed rectangle of the minimum area surrounding the cross section is 0.8 or more.

10. An anode material for non-aqueous electrolyte secondary battery,

the anode material consisting of carbon fiber capable of carrying out doping/undoping of lithium,

wherein the carbon fiber is such that the high order structure of the cross section is random radial type structure, and that value of fractal dimension of the cross section is 1.1 or more and is less than 1.8.

11. A method of manufacturing an anode material for non-aqueous electrolyte secondary battery,

wherein, in applying pressure to softened pitch to carry out discharge/fiber-forming thereof, discharge/fiber-forming is carried out while applying ultrasonic wave to a discharge hole to form precursor of carbon fiber.

12. A method of manufacturing an anode material for non-aqueous electrolyte secondary battery,

wherein, in applying pressure to softened pitch to carry out discharge/fiber-forming, discharge/fiber-forming is carried out while applying magnetic field to a discharge hole to form precursor of carbon fiber.

13. A non-aqueous electrolyte secondary battery comprising:

anode consisting of carbon material capable of carrying out doping/undoping of lithium, cathode, and non-aqueous electrolytic solution in which electrolyte is dissolved in non-aqueous solvent,

wherein, as carbon material constituting the anode, there is included carbon fiber in which the high order structure of the cross section thereof is random radial type structure, and that value of fractal dimension of the cross section is 1.1 or more and is less than 1.8.

14. An anode material for non-aqueous electrolyte secondary battery,

the anode material consisting of carbon fiber capable of carrying out doping/undoping of lithium,

wherein the carbon fiber has cross sectional high order structure in which the central portion is radial type structure and the surface layer portion is random radial type structure.

15. An anode material for non-aqueous electrolyte secondary battery as set forth in claim 14,

wherein when it is assumed that radius of the carbon fiber is R and radius of the portion having the radial type structure is L, L/R is less than 1.

16. A non-aqueous electrolyte secondary battery comprising:

anode consisting of carbon material capable of carrying out doping/undoping of lithium, cathode, and non-aqueous electrolytic solution in which electrolyte is dissolved in non-aqueous solvent,

wherein, as carbon material constituting the anode, there is

included carbon fiber having cross section high order structure in which the central portion is radial type structure and the surface layer portion is random radial type structure.

17. An anode material for non-aqueous electrolyte secondary battery,

the anode material consisting of carbon fiber capable of carrying out doping/undoping of lithium,

wherein the carbon fiber has notch structure at the cross section thereof.

18. An anode material for non-aqueous electrolyte secondary battery as set forth in claim 17,

wherein angle of notch formed at the carbon fiber is 2° or more and is 150° or less.

19. A non-aqueous electrolyte secondary battery comprising: anode consisting of carbon material capable of carrying out doping/undoping of lithium, cathode, and non-aqueous electrolytic solution in which electrolyte is dissolved in non-aqueous solvent,

wherein, as carbon material constituting the anode, there is included carbon fiber having notch structure at the cross section thereof.

20. An anode material for non-aqueous electrolyte secondary battery,

the anode material consisting of carbon fiber capable of carrying out doping/undoping of lithium,

wherein the carbon fiber is carbon fiber formed by crushing

carbon fiber having cross sectional portions periodically different in the crystal structure in a fiber length direction.

21. An anode material for non-aqueous electrolyte secondary battery as set forth in claim 20,

wherein the carbon fiber is such that the aspect ratio is 50 or less, and that the specific surface area by the BET method is 1.5 m^2/g or less.

22. A method of manufacturing an anode material for non-aqueous electrolyte secondary battery,

the method comprising the steps of:

forming organic fiber while applying magnetic field to a discharge hole for discharge/fiber-forming in a pulse form;

allowing the organic fiber thus obtained to undergo infusible processing to implement heat treatment thereto to thereby form carbon fiber having cross sectional portions different in the crystal structure in a fiber length direction; and

crushing this carbon fiber.

23. A method of manufacturing an anode material for non-aqueous electrolyte secondary battery,

the method comprising the steps of:

forming organic fiber while applying ultrasonic wave vibration to a discharge hole for discharge/fiber-forming;

allowing the organic fiber thus formed to undergo infusible processing to implement heat treatment thereto to thereby form carbon fiber having cross sectional portions different in the crystal

structure in a fiber length direction; and

crushing this organic fiber.

24. A non-aqueous electrolyte secondary battery comprising:

anode consisting of carbon material capable of carrying out doping/undoping of lithium, cathode, and non-aqueous electrolytic solution in which electrolyte is dissolved in non-aqueous solvent,

wherein, as carbon material constituting the anode, there is included carbon fiber formed by crushing carbon fiber having cross sectional portions periodically different in the crystal structure in a fiber length direction.